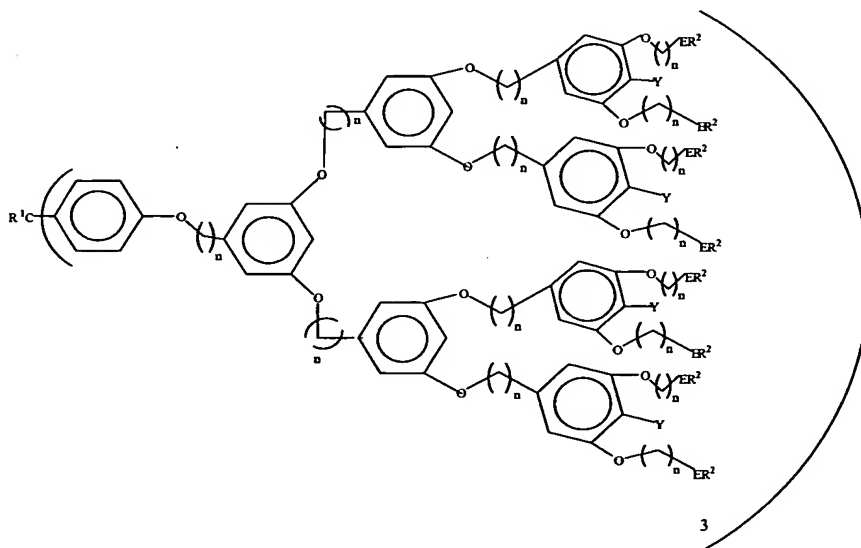
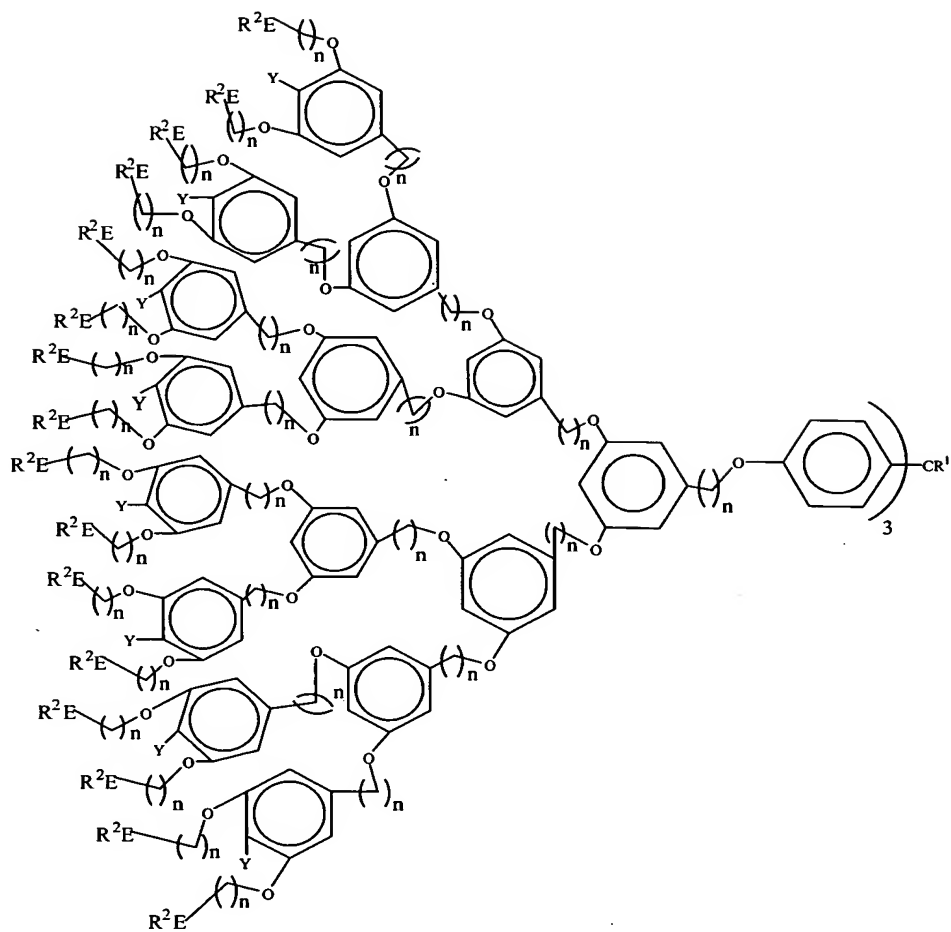


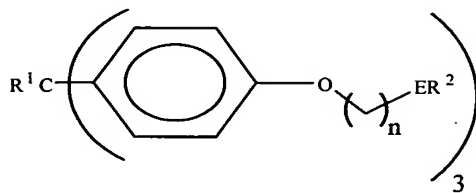
**WHAT IS CLAIMED IS:**

1. A coating composition comprising:  
a sol-gel matrix and  
a dendrimeric organochalcogeno derivative bound to at least a  
5 portion of the sol-gel matrix.
2. The coating composition according to claim 1, wherein the  
sol-gel matrix is a sol-gel processed xerogel.
- 10 3. The coating composition according to claim 2, wherein the  
xerogel is formed from doped or undoped tetramethylorthosilane, doped or  
undoped tetraethylorthosilane, hybrid *n*-propyl-  
trimethoxysilane/tetramethylorthosilane, hybrid bis[3-  
(trimethoxysilyl)propyl]ethylenediamine)/ tetraethylorthosilane, hybrid  
15 tetramethylorthosilane/*n*-propyl-trimethoxysilane/bis[3-  
(trimethoxysilyl)propyl]ethylenediamine), or hybrid tetramethylorthosilane /*n*-  
octyl-triethoxysilane.
4. The coating composition according to claim 1, wherein the  
20 dendrimeric organochalcogeno derivative has the formula:

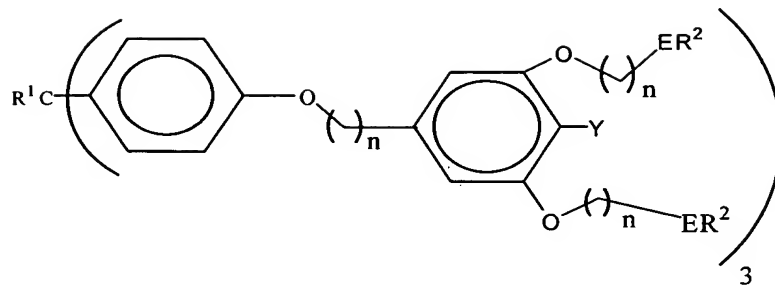




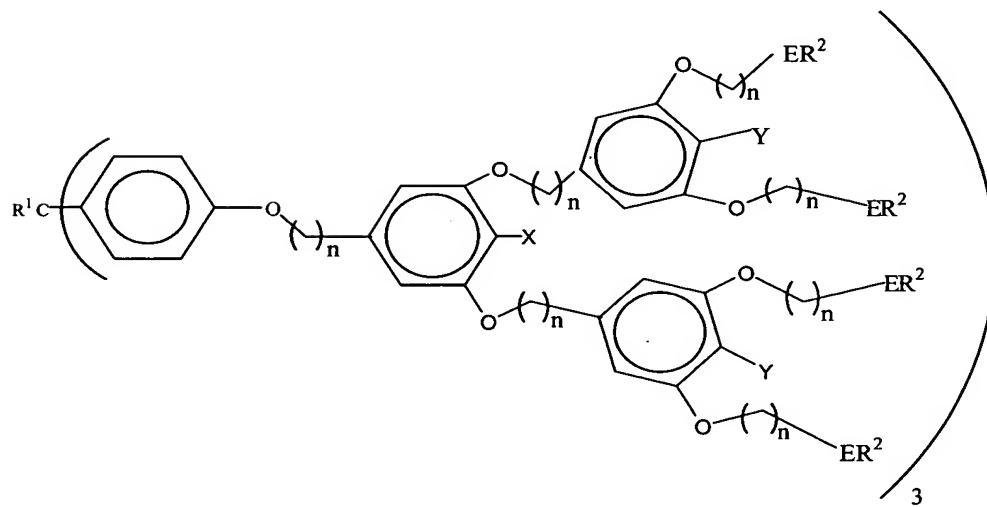
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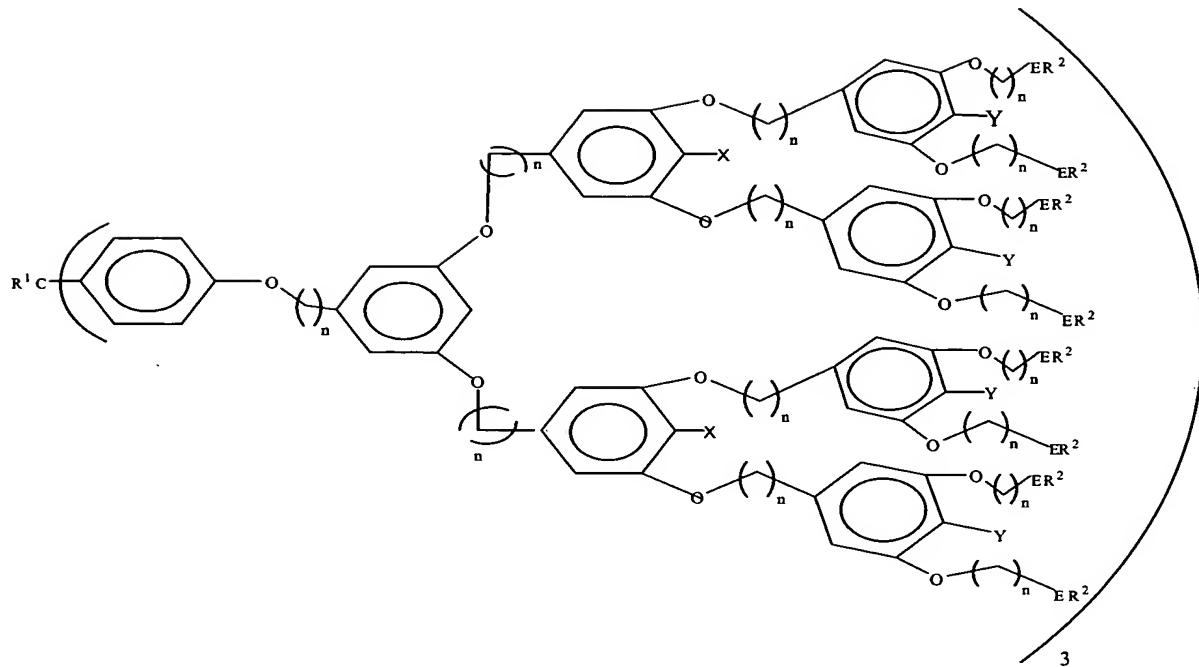
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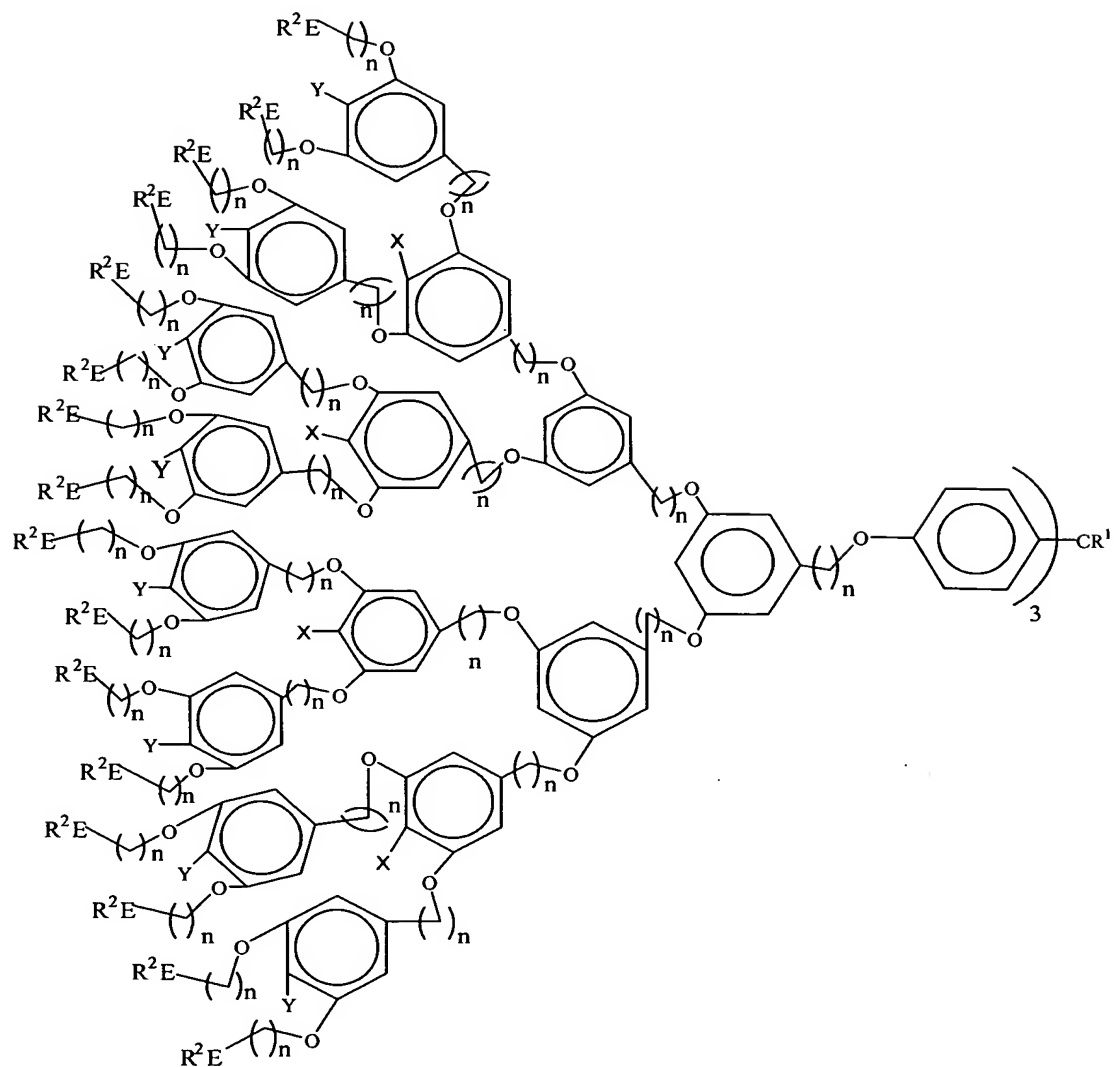


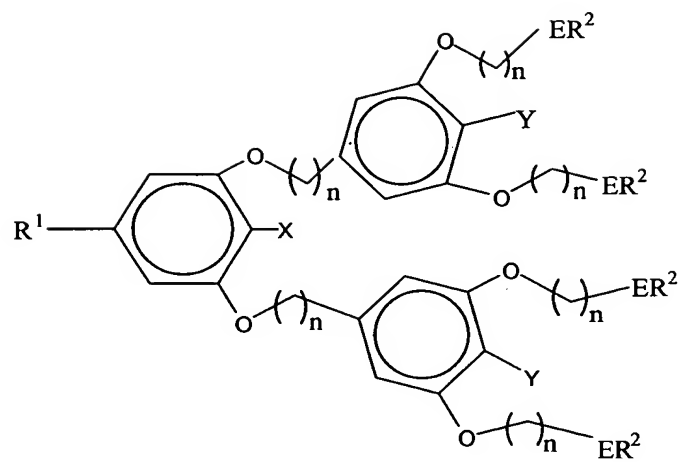
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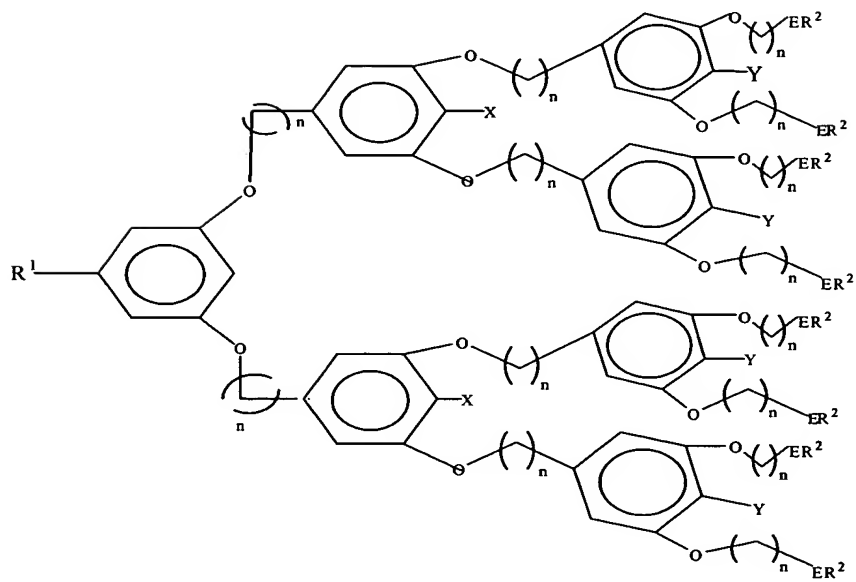
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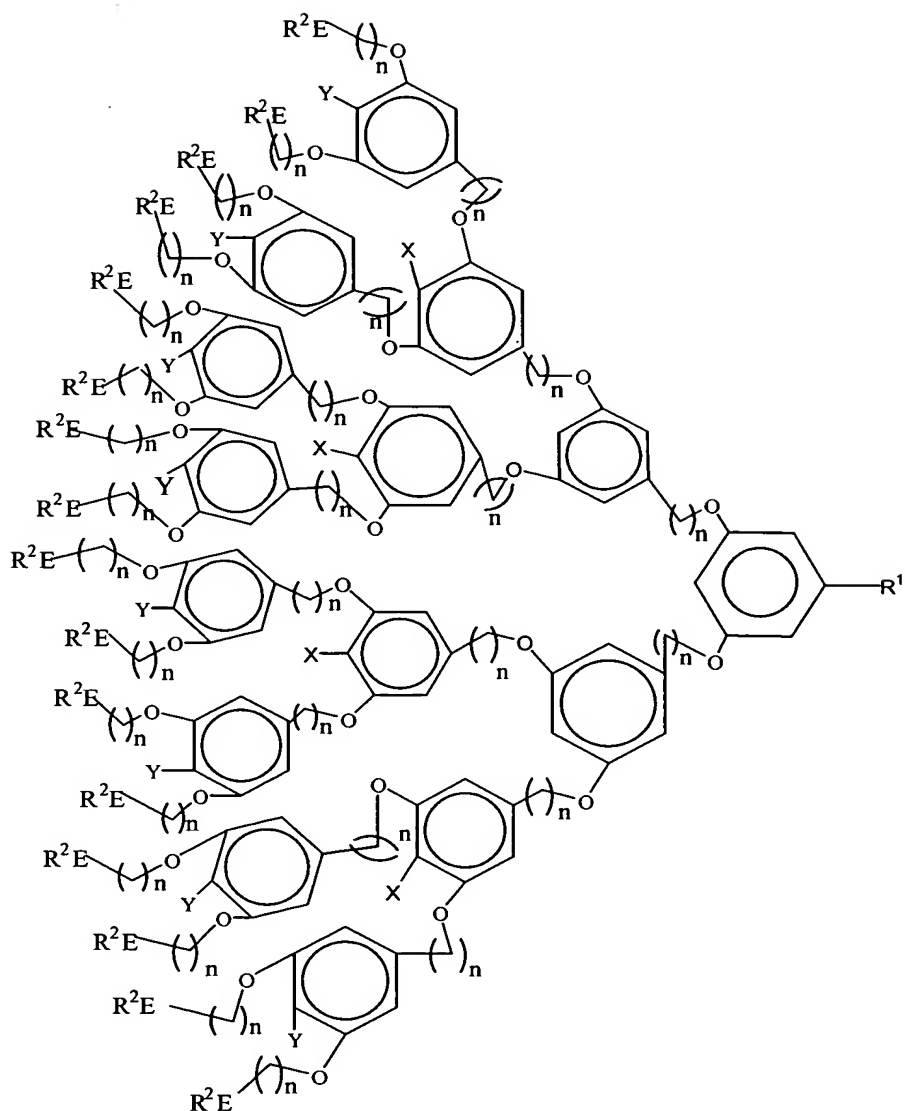




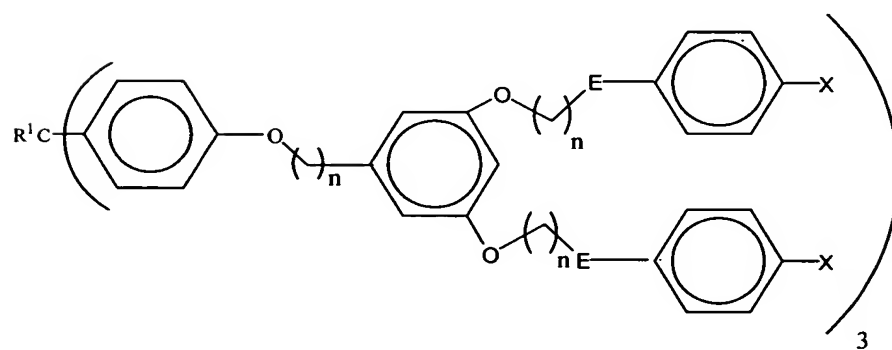
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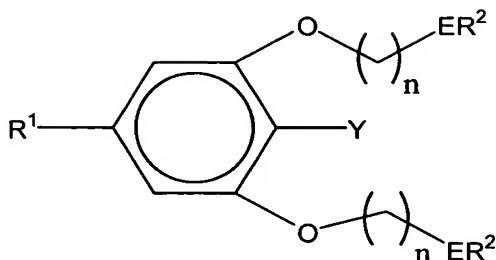
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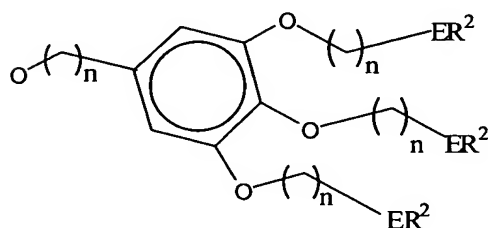
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OR



- 5                    wherein each Y individually is H or  $\text{O}(\text{CH}_2)_n\text{ER}^2$ ,  
                       each X individually is H,  $\text{N}((\text{CH}_2)_n\text{CO}_2\text{Na})_2$  or

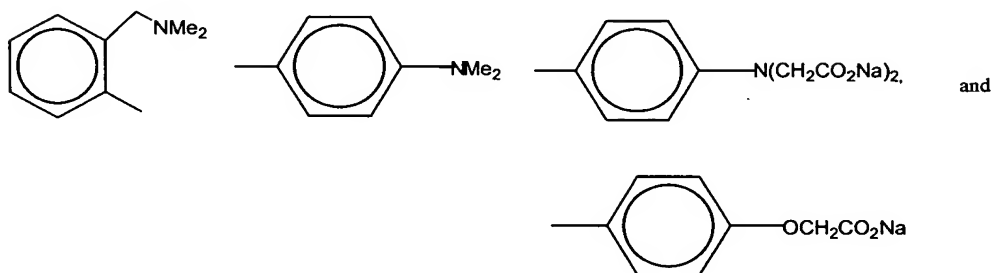


- 10                     $\text{R}^1$  is a substituted or unsubstituted, straight or branched chain C1-  
                       C10 alkyl group, a substituted or unsubstituted, straight or branched chain  
                       C1-C10 alkenyl group, a substituted or unsubstituted aryl group, or a  
                       substituted or unsubstituted heteroaryl group,  
                       each E individually is a chalcogen,  
 15                    each  $\text{R}^2$  individually is a substituted or unsubstituted, straight or  
                       branched chain C1-C16 alkyl group, a substituted or unsubstituted aryl  
                       group, a substituted or unsubstituted heteroaryl group, an ethylene glycol  
                       oligomer, or a perfluoroalkyl group, and  
                       each n individually is an integer from 1 to 16.

- 20                    5.            The coating composition according to claim 4, wherein  $\text{ER}^2$   
                       is selected from the group consisting of  $\text{EPh}$ ,  $4\text{-(CH}_3)_2\text{C}_6\text{H}_4\text{E}$ ,  $4\text{-(CH}_3)_2\text{NC}_6\text{H}_4\text{E}$ ,  
                        $4\text{-HOC}_6\text{H}_4\text{E}$ ,  $4\text{-(CH}_3\text{O}_2\text{CCH}_2)_2\text{NC}_6\text{H}_4\text{E}$ ,  $4\text{-(NaO}_2\text{CCH}_2)_2\text{NC}_6\text{H}_4\text{E}$ ,  $4\text{-}$   
                        $(\text{HOCH}_2\text{CH}_2)_2\text{NC}_6\text{H}_4\text{E}$ , and  $4\text{-(NaO}_2\text{CCH}_2\text{O)}\text{C}_6\text{H}_4\text{E}$ .



6. The coating composition according to claim 4, wherein R<sup>2</sup> is selected from the group consisting of phenyl, *n*-C<sub>6</sub>H<sub>13</sub>,



5

7. The coating composition according to claim 1, wherein the dendrimeric organochalcogeno derivative is non-covalently bound to at least a portion of the sol-gel matrix.

10 8. The coating composition according to claim 1, wherein the dendrimeric organochalcogeno derivative is covalently bound to at least a portion of the sol-gel matrix.

15 9. The coating composition according to claim 1, wherein from about 0.1 wt.% to about 5 wt.% of dendrimeric organochalcogeno derivative is bound to the sol-gel matrix.

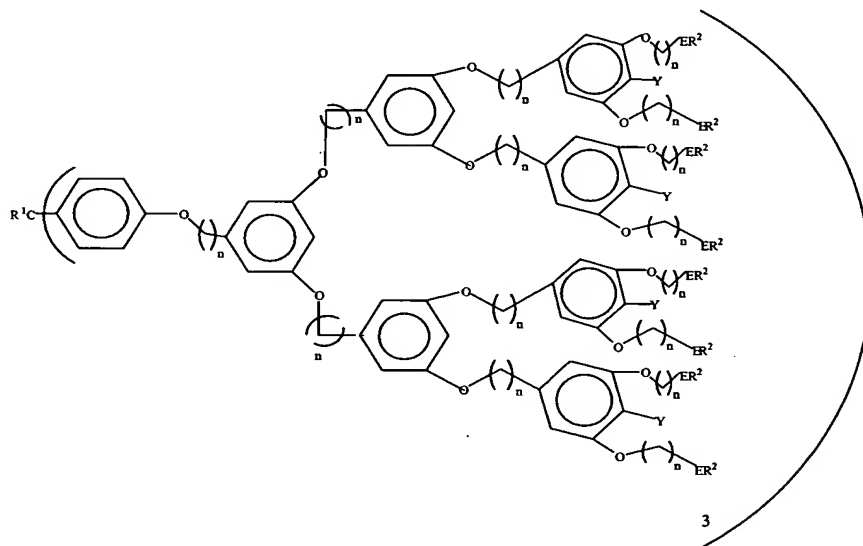
20 10. A system comprising:  
a coating composition comprising  
a sol-gel matrix and  
a dendrimeric organochalcogeno derivative bound to at least a portion of the sol-gel matrix, and  
a substrate, wherein at least a portion of the substrate is coated with the coating composition.

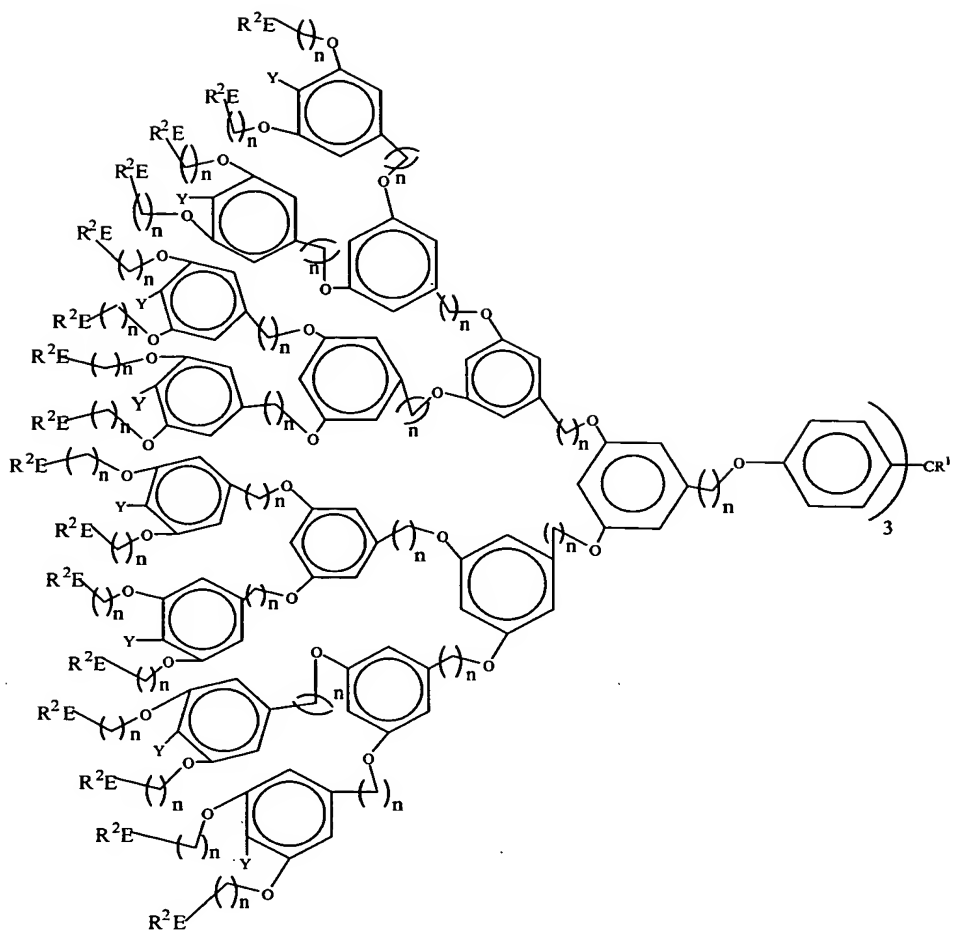
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11. The system according to claim 10, wherein the sol-gel matrix is a sol-gel processed xerogel.

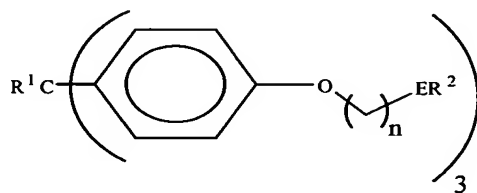
12. The system according to claim 11, wherein the xerogel is formed from doped or undoped tetramethylorthosilane, doped or undoped tetraethylorthosilane, hybrid *n*-propyl-trimethoxysilane/tetramethylorthosilane, hybrid bis[3-(trimethoxysilyl)propyl]ethylenediamine)/ tetraethylorthosilane, 5 hybrid tetramethylorthosilane/*n*-propyl-trimethoxysilane/bis[3-(trimethoxysilyl)propyl]ethylenediamine), or hybrid tetramethylorthosilane /*n*-octyl-triethoxysilane.

13. The system according to claim 10, wherein the dendrimeric 10 organochalcogeno derivative has the formula:

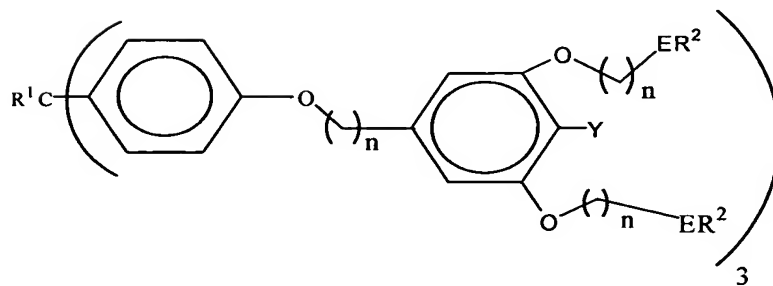




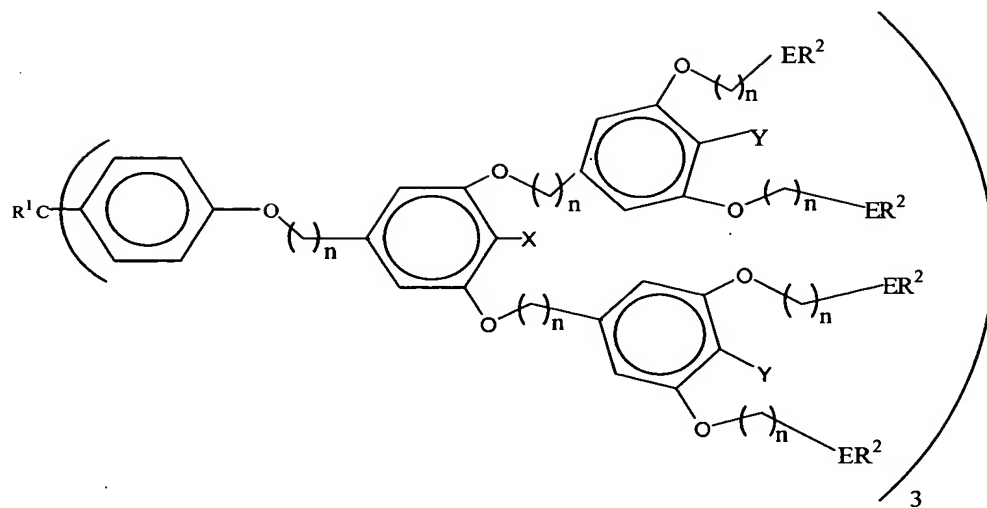
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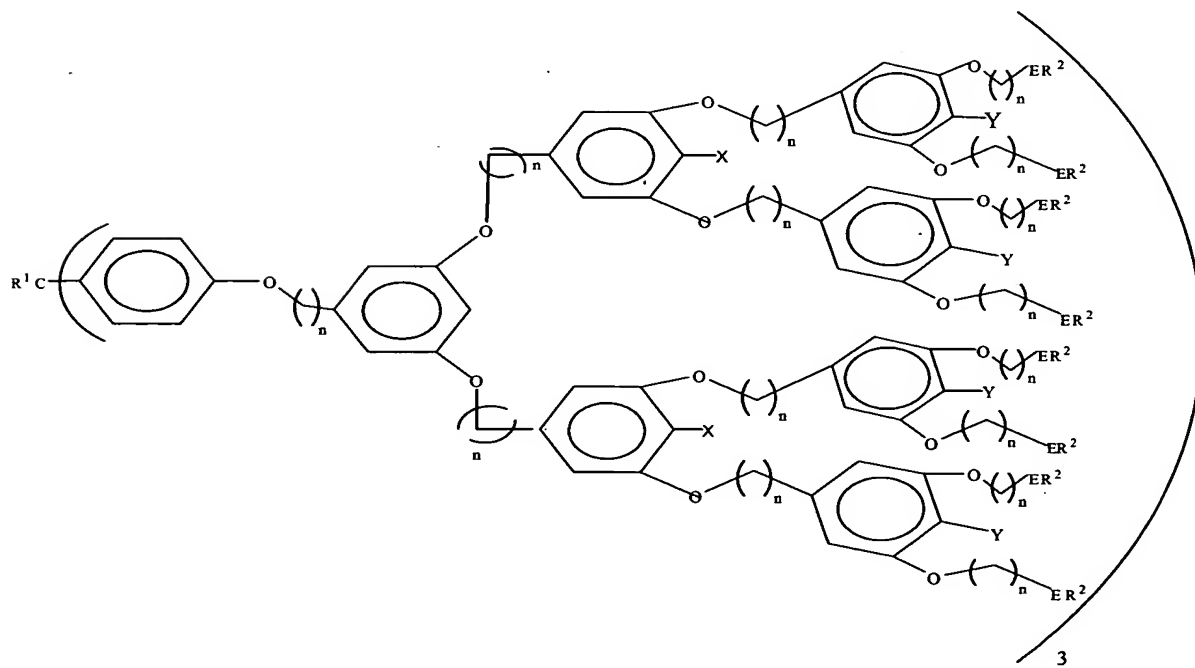
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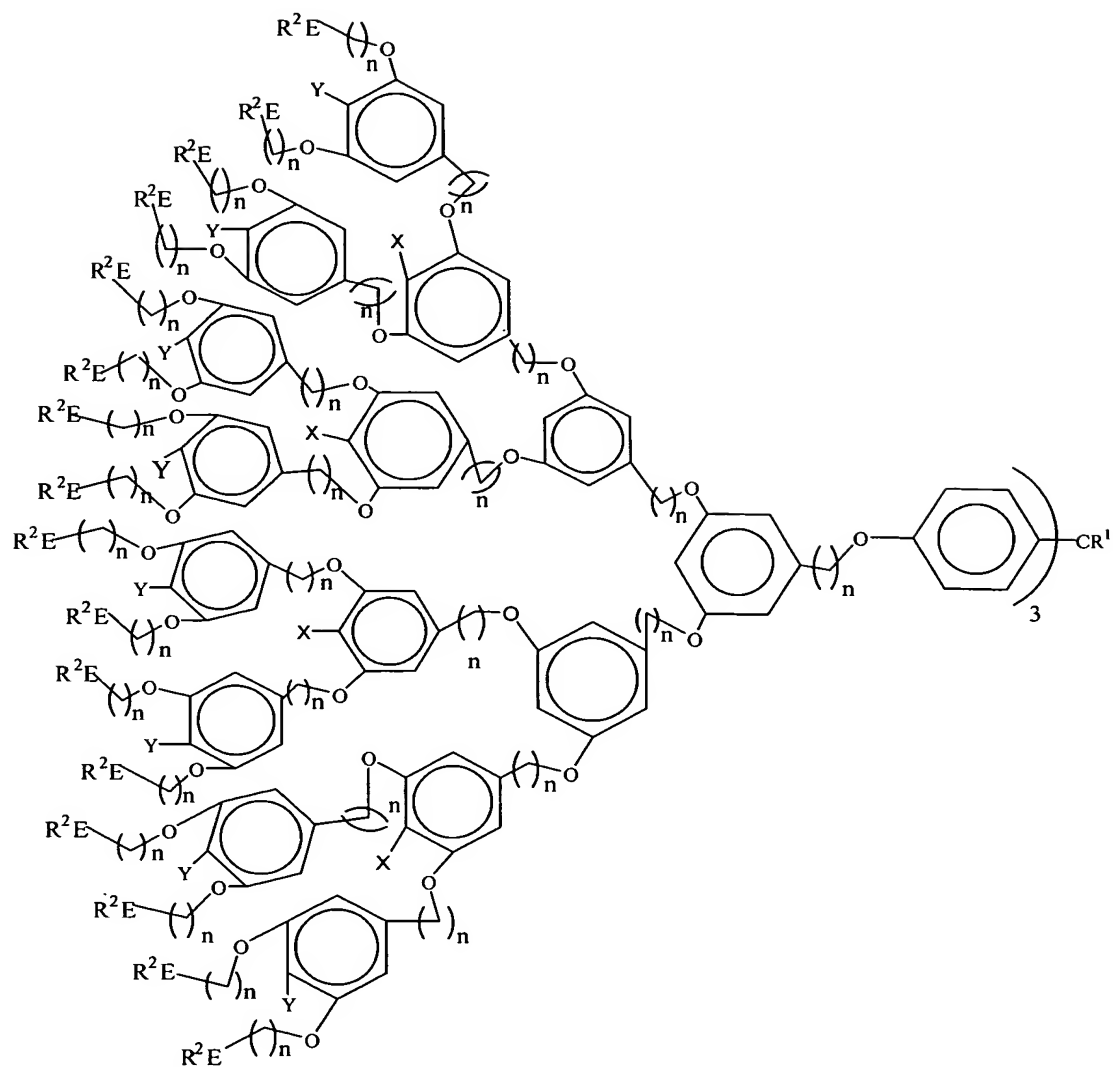
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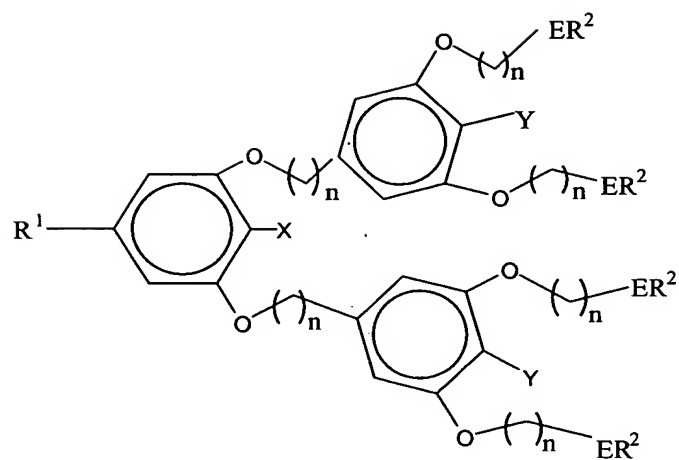


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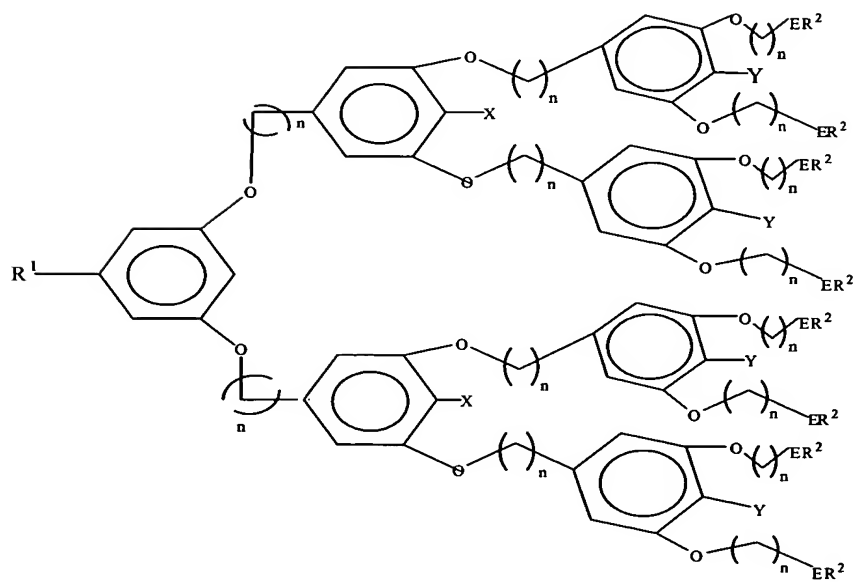


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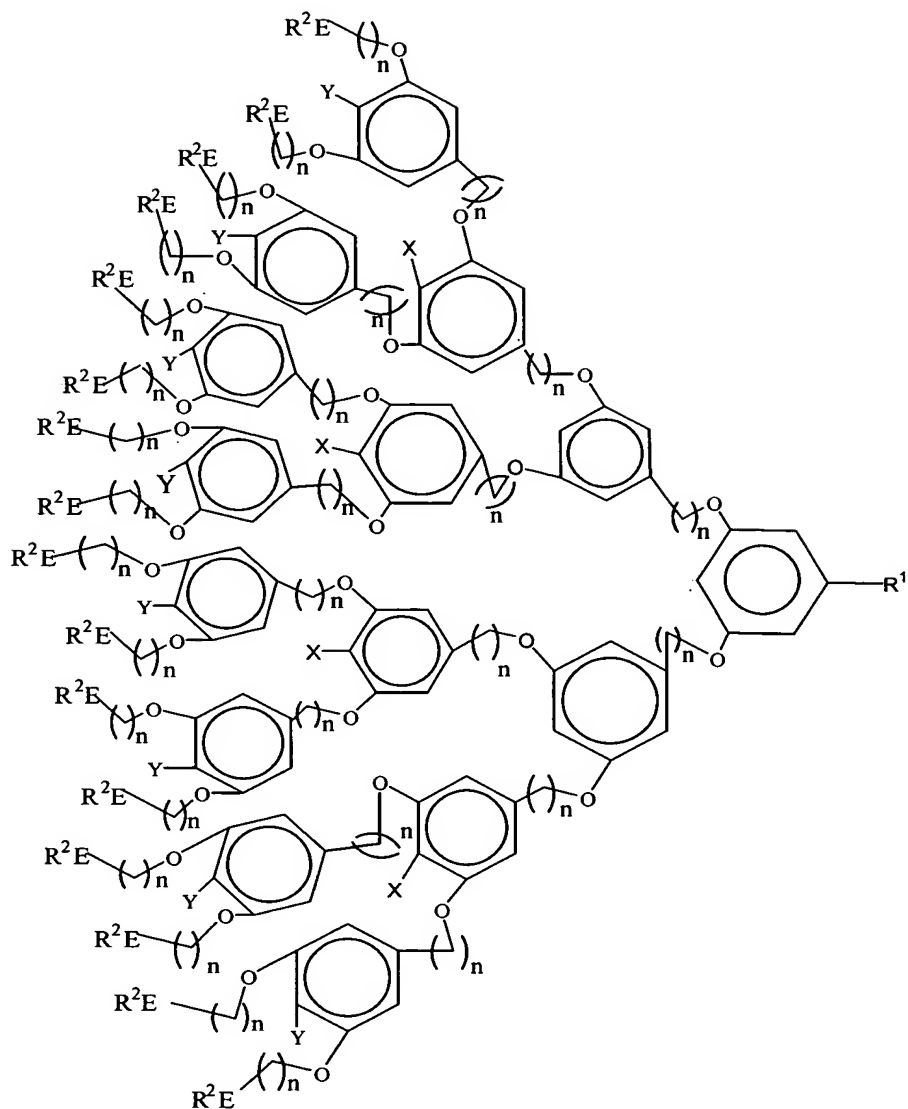




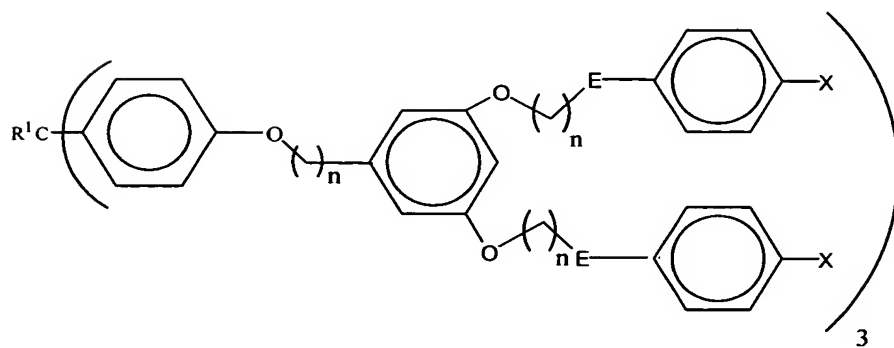
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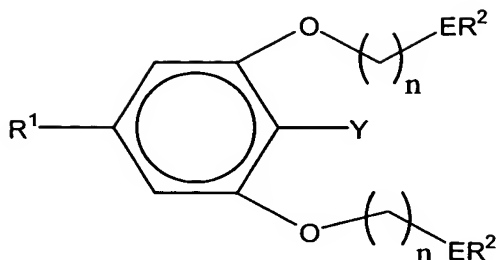
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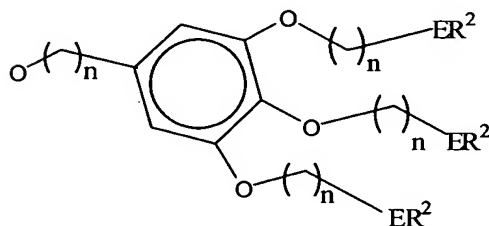
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or



5 wherein each Y individually is H or  $\text{O}(\text{CH}_2)_n\text{ER}^2$ ,  
each X individually is H,  $\text{N}((\text{CH}_2)_n\text{CO}_2\text{Na})_2$  or

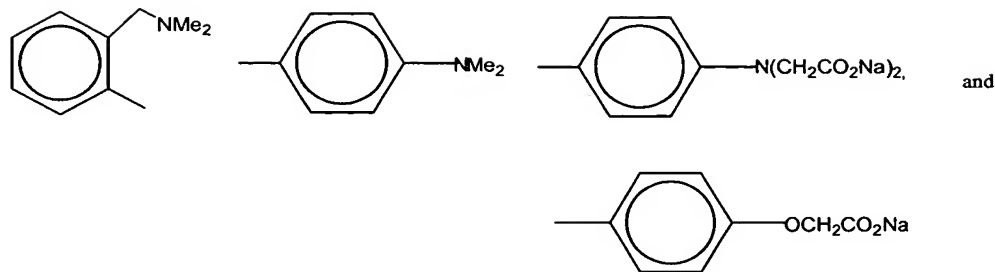


10  $\text{R}^1$  is a substituted or unsubstituted, straight or branched chain C1-C10 alkyl group, a substituted or unsubstituted, straight or branched chain C1-C10 alkenyl group, a substituted or unsubstituted aryl group, or a substituted or unsubstituted heteroaryl group,  
each E individually is a chalcogen,  
each  $\text{R}^2$  individually is a substituted or unsubstituted, straight or branched chain C1-C16 alkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heteroaryl group, an ethylene glycol oligomer, or a perfluoroalkyl group, and  
15 each n individually is an integer from 1 to 16.

14. The system according to claim 13, wherein  $\text{ER}^2$  is selected  
20 from the group consisting of  $\text{EPh}$ ,  $4\text{-(CH}_3)_2\text{C}_6\text{H}_4\text{E}$ ,  $4\text{-(CH}_3)_2\text{NC}_6\text{H}_4\text{E}$ ,  $4\text{-HOC}_6\text{H}_4\text{E}$ ,  $4\text{-(CH}_3\text{O}_2\text{CCH}_2)_2\text{NC}_6\text{H}_4\text{E}$ ,  $4\text{-(NaO}_2\text{CCH}_2)_2\text{NC}_6\text{H}_4\text{E}$ ,  $4\text{-(HOCH}_2\text{CH}_2)_2\text{NC}_6\text{H}_4\text{E}$ , and  $4\text{-(NaO}_2\text{CCH}_2\text{O)}\text{C}_6\text{H}_4\text{E}$ .

15. The system according to claim 13, wherein  $\text{R}^2$  is selected  
25 from the group consisting of phenyl,  $n\text{-C}_6\text{H}_{13}$ ,





16. The system according to claim 10, wherein the dendrimeric organochalcogeno derivative is non-covalently bound to at least a portion of the sol-gel matrix.

17. The system according to claim 10, wherein the dendrimeric organochalcogeno derivative is covalently bound to at least a portion of the sol-gel matrix.

18. The system according to claim 10, wherein from about 0.1 wt% to about 5 wt.% of dendrimeric organochalcogeno derivative is bound to the sol-gel matrix.

19. The system according to claim 10, wherein the substrate is selected from the group consisting of metals, plastics, glass, and wood.

20. A method of preventing fouling of surfaces subjected to a marine environment, said method comprising:  
providing a coating composition comprising a sol-gel matrix, and  
applying the coating composition to a surface subjected to a marine environment under conditions effective to prevent or reduce fouling of the surface.

21. The method according to claim 20, wherein the sol-gel matrix is a sol-gel processed xerogel.

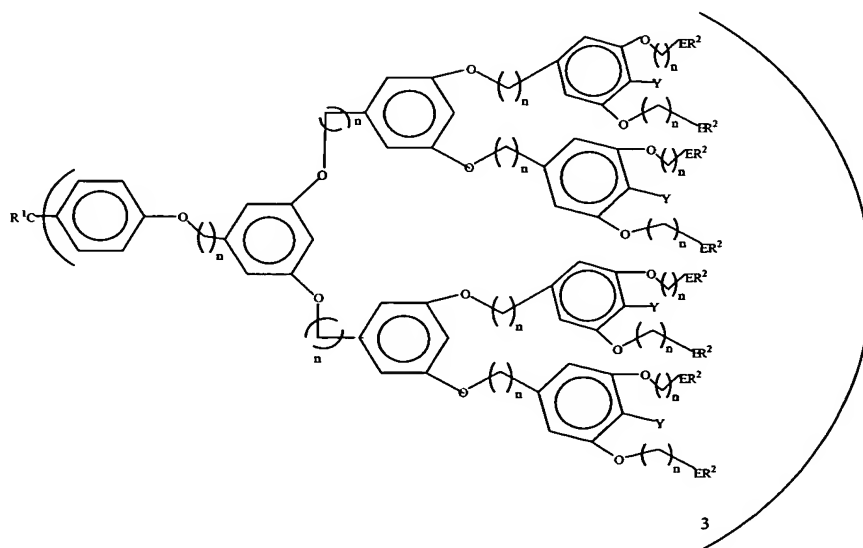
22. The method according to claim 21, wherein the xerogel is formed from doped or undoped tetramethylorthosilane, doped or undoped

tetraethylorthosilane, hybrid *n*-propyl-trimethoxysilane/tetramethylorthosilane, hybrid bis[3-(trimethoxysilyl)propyl]ethylenediamine)/ tetraethylorthosilane, hybrid tetramethylorthosilane/*n*-propyl-trimethoxysilane/bis[3-(trimethoxysilyl)propyl]ethylenediamine), or hybrid tetramethylorthosilane /*n*-octyl-triethoxysilane.

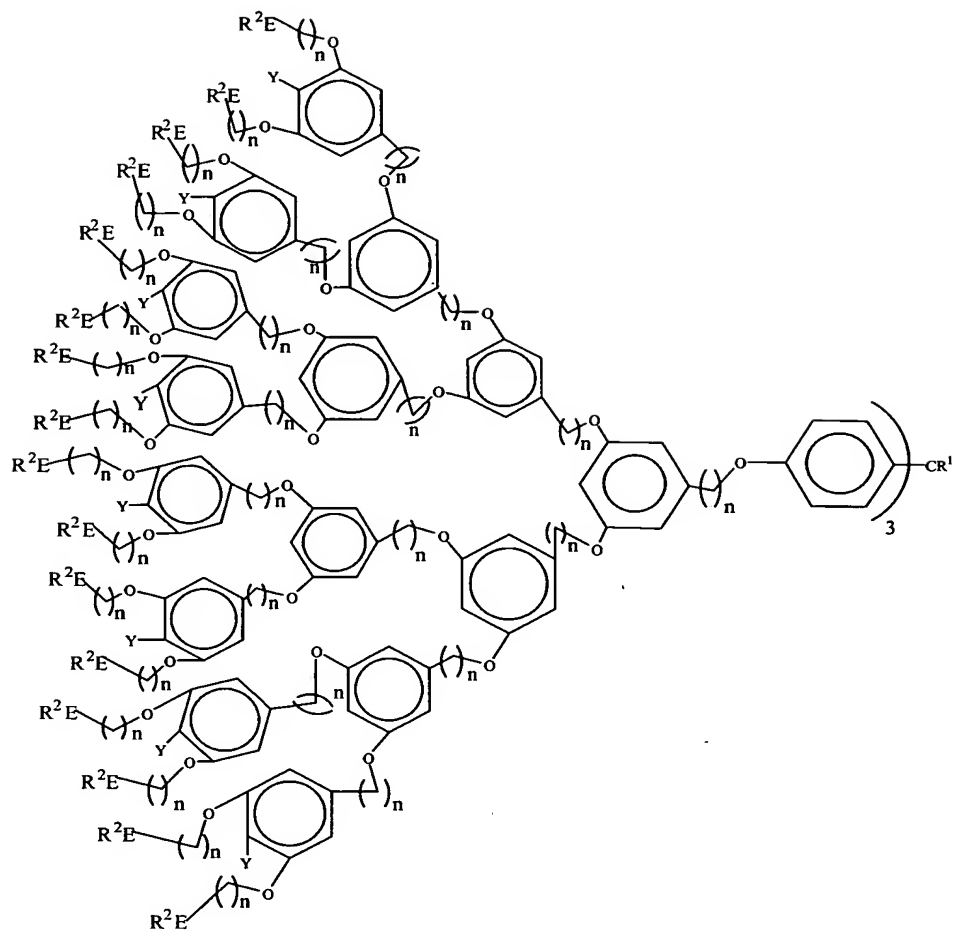
23. The method according to claim 20, wherein the coating composition further comprises a dendrimeric organochalcogeno derivative bound to at least a portion of the sol-gel matrix.

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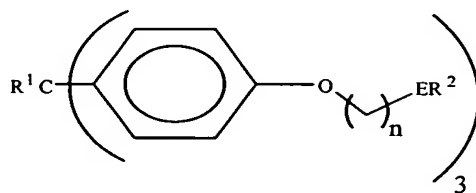
24. The method according to claim 23, wherein the dendrimeric organochalcogeno derivative has the formula:



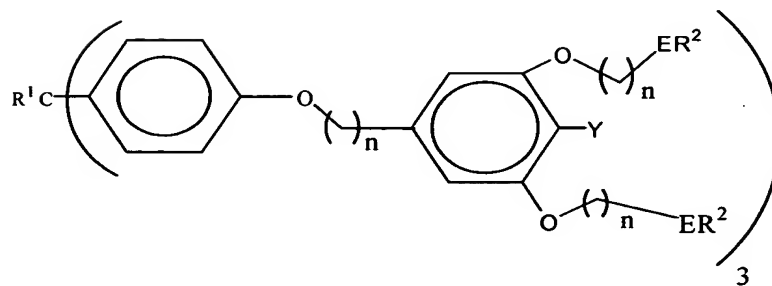
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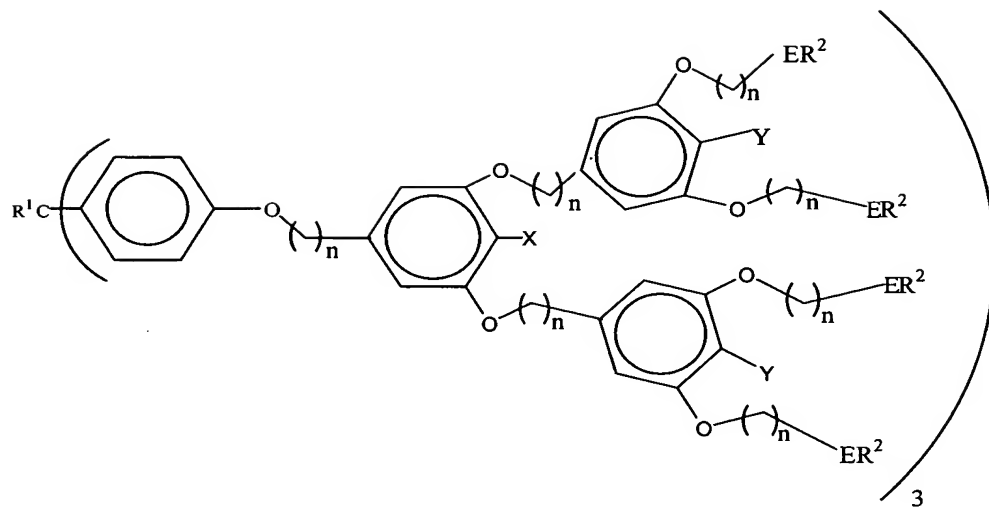
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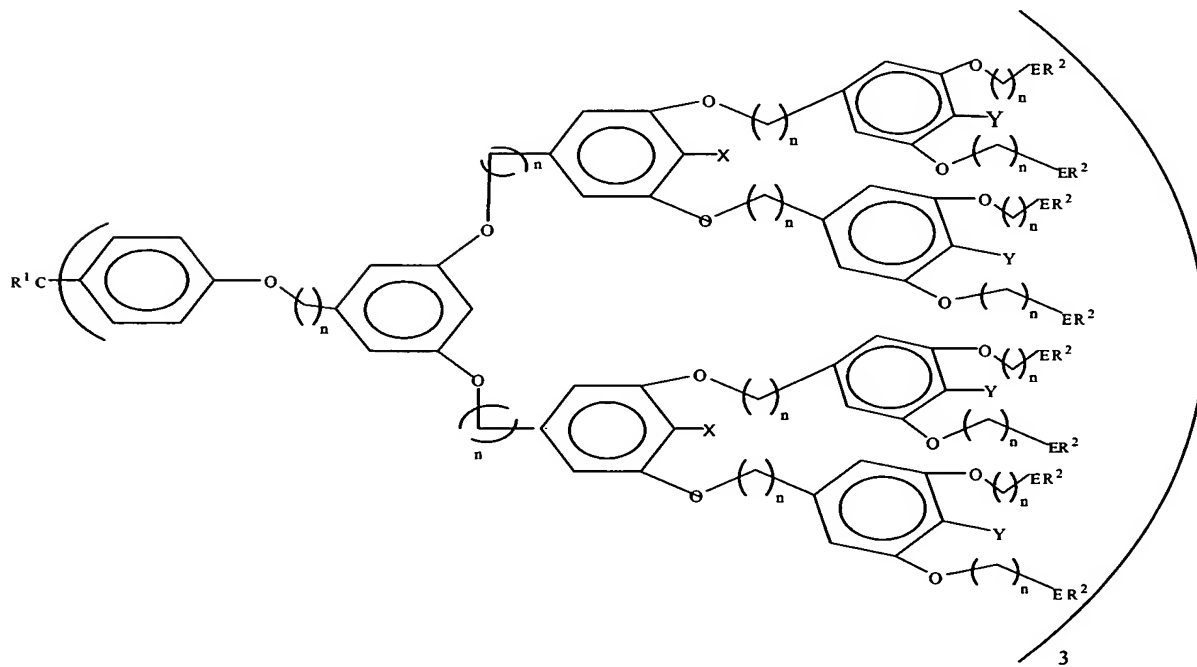
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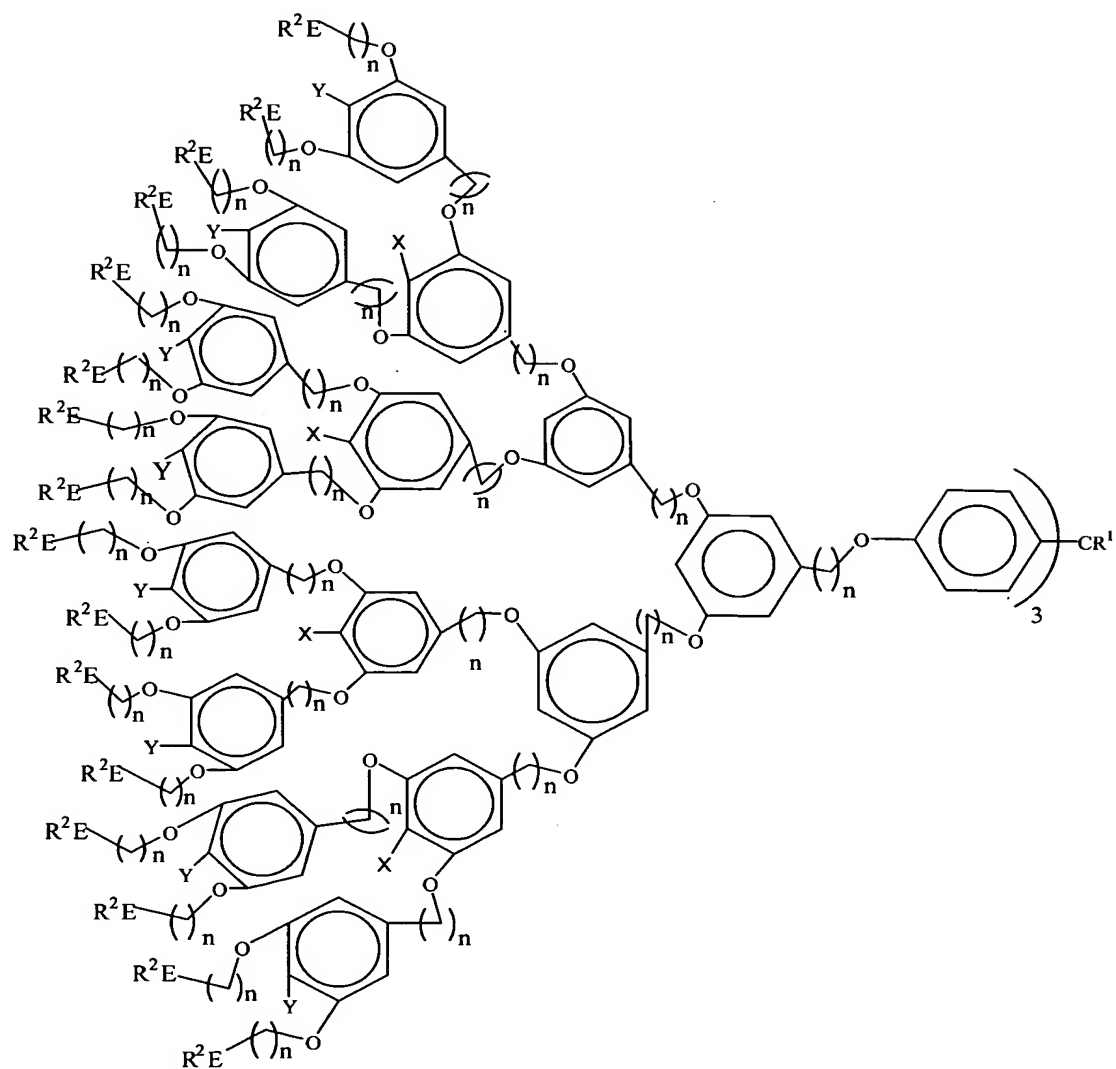
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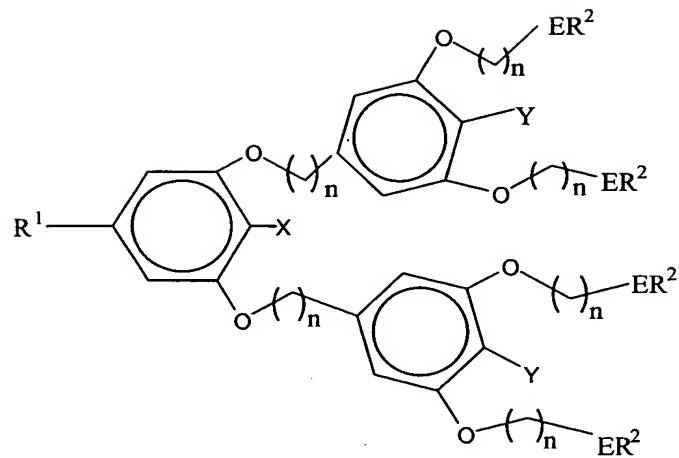


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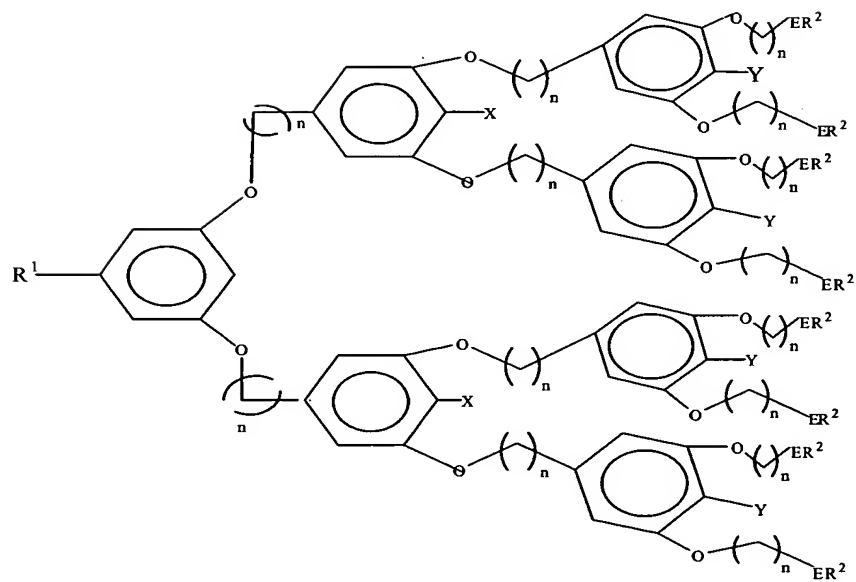


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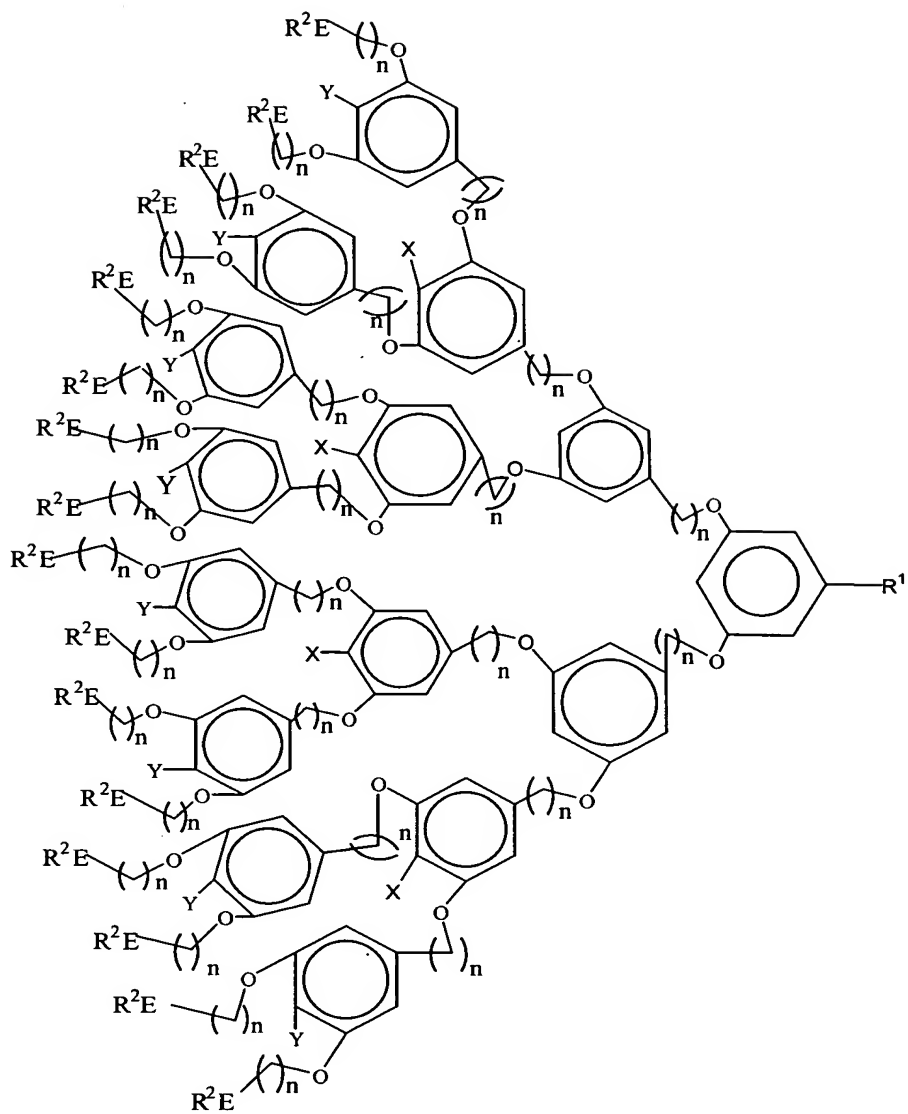




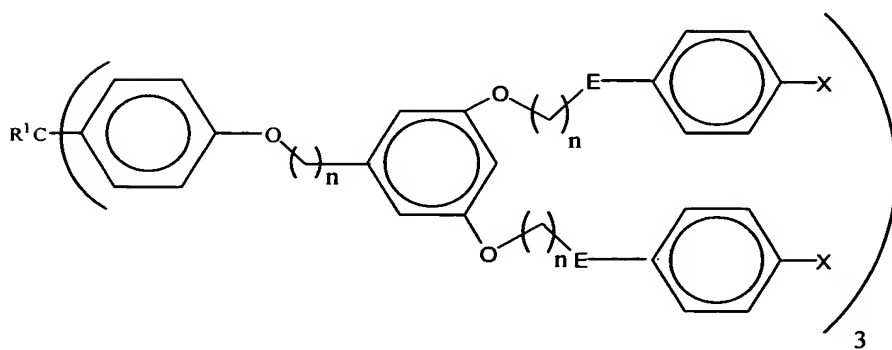
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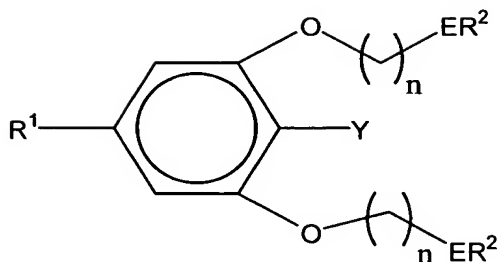
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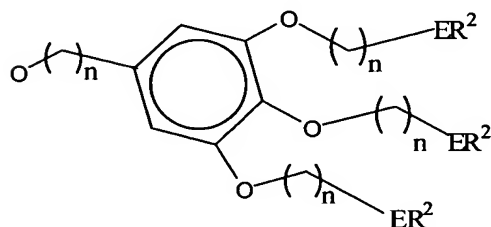


or



wherein each Y individually is H or  $\text{O}(\text{CH}_2)_n\text{ER}^2$ ,  
each X individually is H,  $\text{N}((\text{CH}_2)_n\text{CO}_2\text{Na})_2$  or

5



$\text{R}^1$  is a substituted or unsubstituted, straight or branched chain C1-C10 alkyl group, a substituted or unsubstituted, straight or branched chain C1-C10 alkenyl group, a substituted or unsubstituted aryl group, or a substituted or unsubstituted heteroaryl group,

10

each E individually is a chalcogen,

each  $\text{R}^2$  individually is a substituted or unsubstituted, straight or branched chain C1-C16 alkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heteroaryl group, an ethylene glycol oligomer, or a perfluoroalkyl group, and

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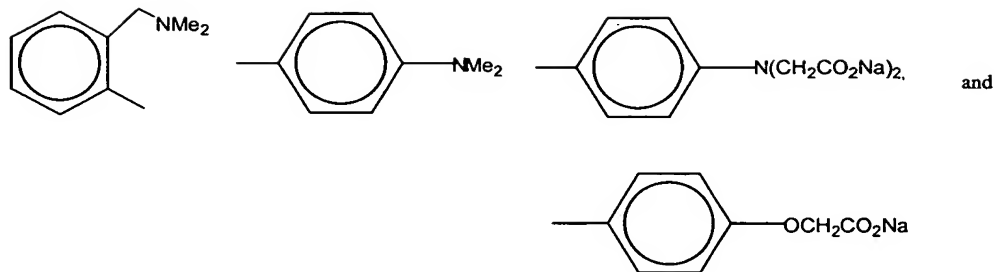
each n individually is an integer from 1 to 16.

25. The method according to claim 24, wherein  $\text{ER}^2$  is selected from the group consisting of EPh, 4- $(\text{CH}_3)_2\text{C}_6\text{H}_4\text{E}$ , 4- $(\text{CH}_3)_2\text{NC}_6\text{H}_4\text{E}$ , 4-HOC<sub>6</sub>H<sub>4</sub>E, 4- $(\text{CH}_3\text{O}_2\text{CCH}_2)_2\text{NC}_6\text{H}_4\text{E}$ , 4- $(\text{NaO}_2\text{CCH}_2)_2\text{NC}_6\text{H}_4\text{E}$ , 4- $(\text{HOCH}_2\text{CH}_2)_2\text{NC}_6\text{H}_4\text{E}$ , and 4- $(\text{NaO}_2\text{CCH}_2\text{O})\text{C}_6\text{H}_4\text{E}$ .

20

26. The method according to claim 24, wherein  $\text{R}^2$  is selected from the group consisting of phenyl, *n*-C<sub>6</sub>H<sub>13</sub>,





27. The method according to claim 23, wherein the dendrimeric organochalcogeno derivative is non-covalently bound to at least a portion of the sol-gel matrix.

28. The method according to claim 23, wherein the dendrimeric organochalcogeno derivative is covalently bound to at least a portion of the sol-gel matrix.

29. The method according to claim 23, wherein from about 0.1 wt.% to about 5 wt.% of dendrimeric organochalcogeno derivative is bound to the sol-gel matrix.

30. The method according to claim 20, wherein the surface is selected from the group consisting of metals, plastics, glass, and wood.

31. The method according to claim 20, wherein applying comprises spraying, dipping, spreading, or brushing.